<u>Using the Basic and Advanced pH Probe Sensors</u>

The instructions in this paper are designed to show:

- How to setup a basic or advanced pH Probe Sensor and set the temperature compensation built into Datadisc.
- How to set up a simple titration using a ScienceScope basic or advanced pH Probe Sensor, a volume sensor, Datadisc and a *Logbook* datalogger*.*
- How to care for your basic or advanced pH Probe Sensor before long-term storage.

Setting up the Basic pH Probe Sensor

Before the using the basic pH probe sensor, it will be necessary to:

- ✓ Prepare some pH 7 buffer solution.
- ✓ Remove the protective soaker bottle from the end of the probe sensor, by turning clockwise, looking at the covered end of the probe sensor. Check that the plastic shroud around the glass bulb is in place before using the probe sensor.
- ✓ During shipment it is possible for air bubbles to move into the glass bulb. To remove the air, shake down the electrode in the same manner as a clinical thermometer until the glass bulb is filled with solution.
- ✓ Set up *Logbook*, by connecting it to the computer, see the Teachers' Guide for help if you need it at this stage.
- ✓ Start the Datadisc software, from the Programs/ScienceScope start-up menu in Windows.
- ✓ Start the meter from the 'measure' menu, after placing the probe sensor in a solution of a carefully prepared pH 7 buffer, agitating and leaving for a few minutes, the 'Set 7' in the Datadisc meter window can be used to recalibrate the sensor to pH 7.
- ✓ Note that the probe sensor contains sensitive electronics. Mains interference can occur from transformers in mixers and other electrical devices.
- ✓ Due to variations inevitable in the construction of the sensor bulbs, each probe sensor will react at different speeds, and each sensor's reaction times will improve with use, after long storage (a few days). See detailed notes for a more precise description of manufacturers tolerances.

Setting up the Advanced pH Probe Sensor

Before the using the advanced pH probe sensor, it will be necessary to:

- ✓ Prepare some pH 10, 7, and pH 4 (or similar weakly acidic) buffer solutions.
- ✓ Remove the protective soaker bottle from the end of the probe sensor, by turning clockwise, looking at the covered end of the probe sensor. Check that th
- ✓ plastic shroud around the glass bulb is in place before using the probe sensor.
- ✓ During shipment it is possible for air bubbles to move into the glass bulb. To remove the air, shake down the electrode in the same manner as a clinical thermometer until the glass bulb is filled with solution.

Calibrating the sensor remotely. Select range 3 on the sensor.

- ✓ Connect the sensor to the *Logbook*, switch it on and observe that pH values are being shown on the meter screen.
- ✓ To calibrate, place the sensor in a sample of pH7 buffer. Let the reading stablise and then press 'Calibrate' on the sensor. Whilst calibrating, the LED will flash. The reading on the meter should change to pH 7. Calibration is now complete and will be retained even when powered off until calibrated again.
- ✓ To fine-tune or calibrate at a different pH value hold down the 'Calibrate' and the 'RANGE' button. Releasing the 'RANGE' button (keeping the 'Calibrate' button pressed) will cause the pH output to increase, slowly at first, then faster after a few seconds. Releasing the 'Calibrate'' button (keeping the 'RANGE' button pressed) will cause the pH output to decrease. When the desired pH level has been reached, release both buttons.
- ✓ If you wish to use temperature compensation, attach a temperature probe, and a pH probe sensor to Logbook, and make a recording. When downloaded to Datadisc the temperature compensated values can be calculated using the Supplementary data feature.

Calibrating the sensor with Datadisc

- ✓ Set up a *Logbook*, by connecting it to the computer, see the Teachers' Guide for help if you need it at this stage.
- ✓ Start the Datadisc software, from the Programs/ScienceScope start-up menu in Windows.

Two point calibration. Select range 1 on the sensor.

- ✓ In Datadisc start the meter from the 'measure' menu, after placing the probe sensor in a solution of a carefully prepared pH 4 buffer (note this is the default value. Other pH values can be used), agitating and leaving until stable. Click on 'Set Cal' in the Datadisc meter window then click the relevant 'Set this value' button, then repeat for the 2nd point after the probe has been placed in the 2nd buffer and settled.

Single point calibration. Select range 2 on the sensor.

- ✓ In Datadisc start the meter from the 'measure' menu, after placing the probe sensor in a solution of a carefully prepared pH 7 buffer (note this is the default value. Other pH values can be used), agitate and leave until stable. Click on 'Set Cal' in the Datadisc meter window and follow the on screen instructions to calibrate at one point.
- ✓ Note that the probe sensor contains sensitive electronics. Mains interference can occur from transformers in mixers and other electrical devices.
- ✓ Due to variations inevitable in the construction of the sensor bulbs, each probe sensor will react at different speeds, and each sensor's reaction times will improve with use, after long storage (a few days). See detailed notes for a more precise description of manufacturers tolerances.

Using Temperature Compensation

Using the meter in Datadisc Pt, select the type of compensation you need from tick-boxes for the supplementary meter channels (at the top of the meter window - may need to scroll down the list of channels to see temperature compensation). There are 2 types, the first (called Temperature Compensation) uses a temperature sensor value, if one is available, and the second (called Fixed Temperature Compensation) uses a value of temperature entered by the user in the meter icon.

Preparing for Long-term storage

- Electrodes should be stored in a 3.0 Molar KCl buffer solution (pH adjusted to 4.0).

Electrode Care and Cleaning

- Slow response and non -reproducible measurements are signs that the electrodes have become coated or clogged. If the glass becomes coated or clogged the time taken to make a measurement will increase (normally 95% of final reading should be achieved in less than 10 secs).
- Rinsing with methyl alcohol should remove the coating and restore the speed of response.
- If the methyl alcohol rinse does not restore the response soak in 0.1 M HCl for five minutes. Remove and rinse with water and place in 0.1 M NaOH for five mins. Remove, rinse again, and soak in 4.0pH buffer for 10 mins before use.
- If a pH electrode is continuously used above 60ºC the outer layer of the pH glass loses its sensitivity This can be restored as follows:-

1. Prepare a 10% solution of ammonium bifluoride. *
2. Immerse electrode for 10 -20 secs.
3. Rinse in water.
4. Immerse in 5 Molar HCl for 5 mins to remove any excess biflouride.
5. Rinse again in water.
6. Soak in 4.0pH buffer for 1 hour before use.

* THIS IS A HAZARDOUS CHEMICAL AND SHOULD ONLY BE HANDLED BY A QUALIFIED CHEMIST FAMILIAR WITH FLUORIDE COMPOUNDS.

- NOTE: All pH electrodes respond best after being stored in slightly acidic solutions such as 4.0 pH buffer.

Filling Solutions

- These electrodes are filled with KCl gel. These do not require filling and have no filling hole on the side of the electrode.

A titration using the Volume sensor and the pH probe sensor

Using Datadisc, a Volume sensor and a pH probe sensor, it is possible to follow the addition of a liquid and the change in pH, simultaneously. Values in brackets are for the 60 cm^3 sensor. To carry out this simple investigation proceed as follows:

1. Connect the pH probe sensor and Volume sensor to a **Logbook** datalogger and connect it to a PC and run Datadisc.
2. Measure out 60 cm^3 (200 cm^3) of 0.1M NaOH in a measuring cylinder and pour it into a 100ml (400ml) beaker.
3. Introduce 17.5 ml (60 ml) of approximately 0.5M HCl in the Volume sensor. Try to ensure that there are no air bubbles introduced as you fill it. Invert the readings on the volume sensor and zero it at the start of the recording.
4. Select Measure/Record... on the Datadisc menu. Select sensor auto and choose Volume for the X axis. Tick the box for 'Select recording channels (including supplementary data) for this recording' and click on 'Go'. Select Volume, and pH to record.
5. Start Datadisc logging and drip at about 3-5 drips per second from the Volume sensor using the pH probe to stir the mixture.
6. Datadisc will produce a graph as the experiment is carried out and you will see the pH change slowly at first and then move through the endpoint.
7. When the investigation is complete you can use the Datadisc calculation functions to calculate the rate of change of pH to identify the endpoint clearly.

This graph shows the result of a similar investigation that we carried out showing the endpoint clearly. Use the Cursor to get a value of the Volume at the endpoint to calculate the concentration of the Alkali solution. In this case the Volume at the endpoint is 12.3 cm^3 giving a concentration of 0.49M

Titration NaOH+HCl

Equipment List:

- A **Logbook** datalogger, a serial lead to connect to the computer, a PC computer with **Datadisc** software installed.
- A **Logbook** pH Probe sensor or pH Interface and Probe.
- A **Logbook** 17.5 cm^3 or 60 cm^3 Volume sensor
- A **Logbook** Pressure (absolute) sensor
- A small piece of plastic tube
- 100 ml or 200 ml 0.5 M Hydrochloric Acid.
- 20 ml or 60 ml 0.1 M Sodium Hydroxide.
- A 100 ml 0r 400 ml beaker.

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